REVIEW ARTICLE

Bladder outlet obstruction in women

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ABSTRACT

Bladder outlet obstruction in females remains a poorly understood condition and is much rarer as compared to males. More difficult is the objective diagnosis of this condition. There is no general agreement on the Urodynamic parameters to define the condition with certainty. A number of conditions are involved particularly in urinary retention in females are not completely understood. Besides, external sphincter dysfunction and post surgical retentions add another group of conditions which are distinct from retentions seen in the males. This article takes a review of various aetiological factors of Bladder outlet obstruction in women. An attempt is made to standardise the Urodynamic parameters for use in females, based on our data and experimentation on the models of the bladder and urethra. This article also takes a review of uncommon conditions such as Fowler's syndrome which often complicate evaluation of this condition.

Key Words: Bladder outlet obstruction in women, urinary retention in females, urodynamic diagnosis of bladder outlet obstruction

INTRODUCTION

Bladder outlet obstruction in females is a relatively uncommon condition in clinical practice. However determining outlet obstruction in females still remains an intriguing proposition. Besides, the management of bladder outlet obstruction in females is perhaps as complex as its diagnosis.

The etiological factors for outlet obstruction are more diverse in females than in males. Secondly, the Urodynamic criteria, so well researched for the diagnosis of Bladder outflow obstruction in the male, are not applicable to the female bladder outlet due to a different pressure flow relation. Lastly the dynamics of voiding in females also is more complex than in the males, presumably due to mobility of the bladder neck and proximal urethra as well as due to the action of pelvic floor movements and fasciae over the urethra. Besides, presence of pelvic organ prolapse adds a different dimension to the dynamics of voiding in females.

STRUCTURAL ANATOMY OF THE FEMALE BLADDER OUTLET [FIGURE 1]

Bladder neck is a weak link in the continence mechanism and can be shown to be incompetent even in nulliparous women.

External sphincter complex is composed of three components as in the females. The innermost intrinsic smooth muscle sleeve has a longitudinal orientation, and is noradrenergically innervated. Its role in the continence mechanism remains debatable to date.

The striated urethral sphincter or the so called Intrinsic

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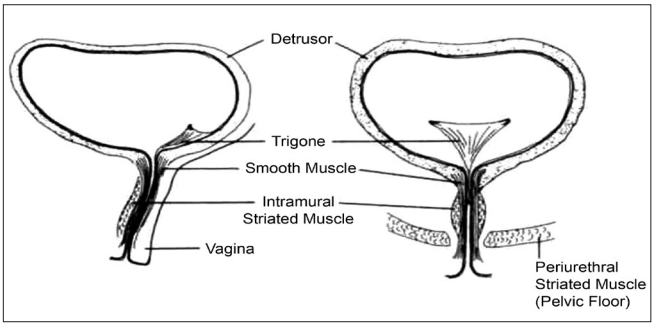

Figure 1: Anatomy of the female urethra: Linear diagram

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Rhabdosphincter is a definite mass of striated muscles which have a circular orientation. This is thickest in the central portion of the urethra and its thickness tapers of towards the bladder neck and towards the external urethral meatus.

Indeed this muscle is made of "slow twitch" striated fibers, which are capable of prolonged contraction. The reason this muscle is thickest anterierly is because it is oriented in a number of bundles and some of its bundles wrap the urethra from the sides and then become incorporated into the anterior and lateral vaginal walls.

Although it's an intrinsic urethral muscle, it is supplied entirely by the pudendal nerve. The third component is of course the muscle mass of the pelvic floor which essentially surrounds the external rhabdosphincter but is made mainly of "fast twitch" fibers like other skeletal muscles.

DEFINING BLADDER OUTFLOW OBSTRUCTION IN FEMALES

Since the history of urinary symptoms holds poor correlation to the pathology, it must be interpreted with caution and must be complemented by imaging and other laboratory parameters in order to arrive at the precise diagnosis if bladder outlet obstruction in women.

History

A good history and a thorough clinical examination still have a very important role in investigation. Urinary infection must be diagnosed by culture and treated appropriately. Pelvic ultrasound should underline cause like a large fibroid or an ovarian cyst compressing against the urethra. Although urinary symptoms generally have a limited value in the clinical diagnosis of outlet obstruction, voiding symptoms such as poor urinary stream, hesitancy, straining and sense of incomplete emptying are clearly suggestive of outlet obstruction in women.

On physical examination

Palpable distended bladder should clinch the diagnosis. Urethral stricture is generally not felt on vaginal palpation, but conditions like urethral caruncle, diverticulum and carcinoma should be obvious.

Ultrasound

Is a very useful investigation in evaluation of Bladder outlet Obstruction even in women. Although the presence of residual urine volume does not necessarily give away the diagnosis of Bladder outlet Obstruction in women, it should be looked upon as an important criterion in the presence of relevant symptoms. Uroflowmetry is by far a very important and yet poorly utilized tool in the evaluation of female Bladder outlet Obstruction. There is a large variation in the values of peak flow and mean flow in our population. Yet any Uroflow with a consistent peak flow of less than 15 mls/second on a voided volume of over 150 mls. should clearly suggest Bladder outlet Obstruction in a female, particularly in the absence of a gross Pelvic Organ Prolapse.

Cystoscopy

Remains an invasive yet useful investigation in the diagnosis of Bladder outlet Obstruction in women. However considering its therapeutic potential it should be used as the final tool in the flow chart of investigations. Cystoscopic evaluation can be used to determine the site of obstruction, once the presence of obstruction is confirmed on Urodynamics.

Painful stimulus arising from the pelvic organs can reflexly inhibit detrusor contraction leading to retention. Treatment should be directed towards elimination of pain and its sources. Inadvertent overdistension of the bladder following labour or a gynecologic surgery may lead to detrusor paralysis for varying length of time. These cases may simply need continuous catheter drainage and periodic voiding trials.[1]

There is enough Urodynamic evidence that clamping the catheters is not only useless but potentially dangerous (in terms of triggering systemic infection).

Urethral stricture occurs in females in the form of fibrous stenosis in the distal portion. Although the precise aetiology is not understood, prolonged second stage of labour and post menopausal hormonal changes have been blamed. While – urethral stricture is generally amenable to deep Uretherotomy (with an Otis Urethrotome), there is a definite recurrence rate in the long term. Although the precise incidence of this condition in the Indian population is not known, it probably accounts for as high as 3% to 5% of women, reporting with urinary symptoms to our clinics (personal communication[2]).

Primary bladder neck obstruction is rare in women, presumably because there is no structural bladder neck. Incisions of the bladder neck, although advised by many authorities, have a real risk of producing urinary incontinence.[3,4] The use of alpha adrenergic blocking agents is still debatable, since the role of alpha adrenergic receptors in the urethra is not completely understood.[5]

Although the precise treatment must be dictated by the exact cause in the individual case, the aetiology of obstruction remain obscure in many women.

Thus in a routine clinical setting, the clinician should be able to make a diagnosis of Bladder outlet Obstruction in women based on the voiding symptoms, high residue on ultrasound and Uroflowmetry combined. However, in the era of evidence base, an objective evaluation of the bladder dynamics becomes mandatory in the precise diagnosis of Bladder outlet Obstruction, both in men and women.

Multichannel Urodynamics still remains the mainstay in the diagnosis of bladder outlet obstruction in females. Addition of Video can further enable us to localize the site of obstruction.

Urodynamic considerations

Normal voiding is characterised by a sustained and voluntary contraction of the detrusor of adequate magnitude, enough to evacuate the contents completely. This is always accompanied by a "coordinated and sustained" relaxation of the external urethral sphincter and the entire pelvic floor until complete emptying is achieved [Figures 2 and 3].

Bladder outflow obstruction entails increased urethral resistance with a variable effect on the detrusor muscle. This in turn changes the dynamics of voiding and produces symptoms as well as pathological changes in the bladder in some cases, the upper urinary tracts.

In the male benign hyperplasia of the prostate or stricture of the urethra dominates the list of etiological factors of obstruction.

In the females the condition of Bladder outflow obstruction is poorly understood till date.

Although urethral stricture is still the commonest cause, the list of conditions causing obstruction is diverse and can be summarized [Table 1].

Table 1: Causes of bladder outflow obstruction and urinary retention

Anatomical	
Extrinsic	Pelvic organ prolapse, uterine fibroid or tumor, post-anti- incontinence procedure
Urethral	Stricture, meatal stenosis, urethral caruncle, Diverticulum, skene's gland cyst.
Luminal	Stone, bladder/urethral tumor, uretercoele, foreign body
impaired detrusor	
Contractility	Senile bladder changes, neurological disease (diabetes mellitus, other peripheral neuropathy)
Functional	Fowler's syndrome, dysfunctional voiding

URODYNAMIC DIAGNOSIS OF BLADDER OUTFLOW OBSTRUCTION IN WOMEN

A lot of work has taken place to define the Urodynamic diagnosis of Bladder outflow obstruction in men. However the criteria for obstruction in women have not been standardized.[6]

Although the relationship of detrusor pressure and uroflow is generally accepted to determine the urethral resistance, the labile nature of bladder neck and urethra in a female tends to complicate the evaluation. However, addition of video imaging of the outlet seems to give more accurate information on obstruction in women.[7]

Nitti and associates[8] defined Bladder outflow obstruction as radiographic evidence of urethral occlusion in the presence of sustained detrusor contraction of any amplitude. They further mentioned that this contraction is usually associated with reduced or delayed flow rate.

Dikono[9] suggested that detrusor pressure in excess of 60 cms of water and peak flow rate of less than 15 mls/sec should be accepted as obstruction in women provided there is video evidence of funneling of the bladder neck and relaxation of the urethral sphincter during voiding.

Blaivas was the first investigator to introduce a Nomogram for the diagnosis of Bladder outflow obstruction in women.[6]

He plotted Q_{max} of the catheter free flow on the X axis and the Pdet Q_{max} on the Y axis. Thus Q_{max} of free flow of <12 mls/sec and Pdet Q_{max} of >20 cms was thought to constitute obstruction. The nomogram also gave away the degree of obstruction in the form of mild, moderate and severe.[10] Despite these pieces of work, there is still no agreement on the precise determination of Bladder outflow obstruction in women [Figure 4].

We, at The Center for Advanced Urodynamics Ratna Memorial Hospital Pune, have been working on conventional pressure flow study in order to define the Bladder outflow obstruction in the process of underactive detrusor in men.

It is generally believed that urethra (male or female) is an irregular structure and is dynamically active

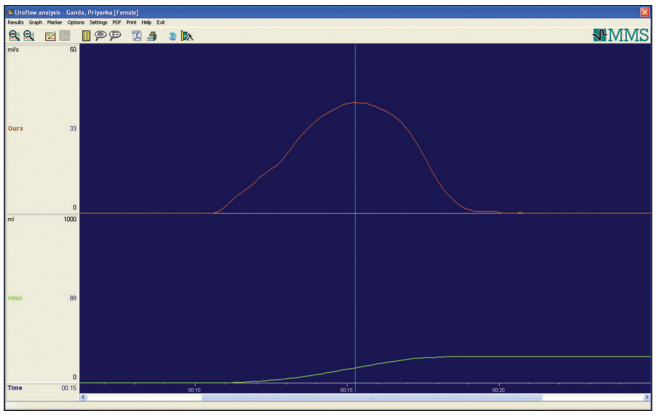

Figure 2: Normal uroflow trace in a female

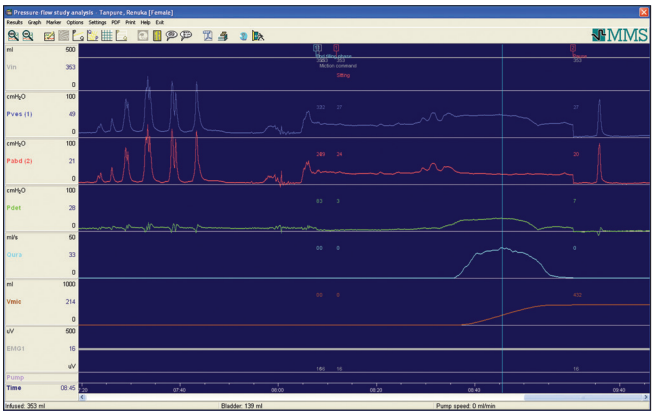

Figure 3: Normal urodynamic tracing of pressure and flow realation

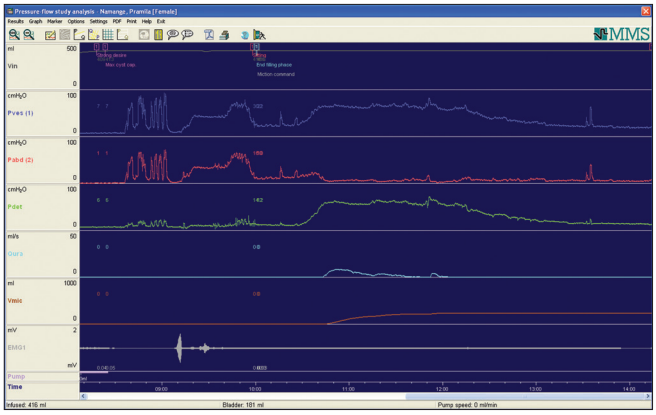

Figure 4: Urodynamic tracing of bladder outlet obstruction in a female

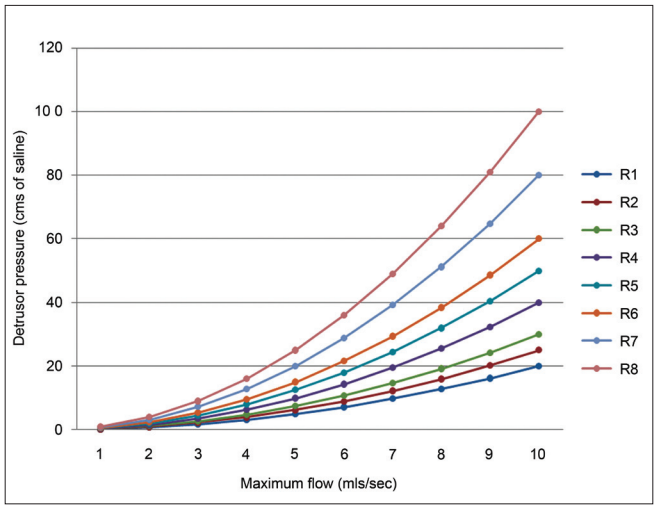

Figure 5: Urethral resistance is given by the modified Hill Equation: $R = P/Q^2$. Each of these curves represents different values of detrusor Pressure and flow at a constant urethral resistance. The point of Pdet Q_{max} of a voiding cycle, when plotted on this chart, shall precisely determine the value of urethral resistance

throughout the voiding phase. Thus the principles of the rigid tube hydrodynamics cannot be applied to this model. However, when we think of estimating the total urethral resistance, the point of maximum flow (Q_{max}) is about the only point of time when the urethra is at its widest diameter. This point of time therefore offers the best possible opportunity to apply the established principle of hydrodynamics in calculating, at best, the total urethral resistance offered by the static structure in the urethra.[6]

According to modified Hill equation, resistance of a rigid tube can be given by the formula:
$R = P/Q^2$ (where R is the resistance, P is the pressure and Q is the flow)

Thus if we plot synchronous values of pressure (Pdet Q_{max}) on the Y axis and flow (Q_{max}) on the X axis for given resistance, their graphic relation generates an exponential curve. In fact a number of such curves can be generated using different values of urethral resistance [Figure 5].

Each of these curves represents different values of detrusor Pressure and Flow at a constant Urethral Resistance. The point of PdetQ_{max} of a voiding cycle, when plotted on this chart, shall precisely determine the value of urethral resistance.

Since we know what values of flow and pressure (Q_{max} and Pdet Q_{max}) cause clinical obstruction in men, any points falling above this line can be accepted as obstruction.

We feel that these parabolas can also be extended to determine urethral resistance in females. Depending on what values of pressure or flow can cause symptoms and / or pathological changes, the values of obstructed and unobstructed can be defined arbitrarily. There is another advantage. Parabolic graphs of differing values of resistances can also give us the degree of obstruction by plotting the values of Pdet Q_{max} and Q_{max} on these curves.[11-13] It would be more useful to compare these flow rates with catheter free flow rates, since this will

take away any artifacts that may occur in the presence of pressure catheters in the urethra [Figure 5].

Difficulty often arises in cases where female bladder is underactive. Females generally void at a very low detrusor pressure. This is mostly because they have a low urethral resistance and the pressure is not allowed to build up in the presence of high flow.[14]

This happens despite the fact that the contractility of detrusor is normal. If the detrusor contraction is weak it is expected that entire pressure flow equation will be scaled down, given that the magnitude of resistance is the same. Again the basic parabolic equations should give away the diagnosis of obstruction even in the case of significantly underactive detrusor (provided the available contraction is able to produce the flow).

By knowing the cut off points of resistance beyond which the outlet can be called obstructed one can not only diagnose Bladder outflow obstruction but can also quantify the resistance, thereby giving away the magnitude of severity of outlet obstruction.[15]

Many women have a very high post void residual urine volumes. Impaired detrusor contractility is more common aetiology of bladder outlet obstruction but the final verdict again depends on the properly conducted pressure flow studies. The cause of underactive detrusor ranges from age to multiparity, diabetes and other peripheral neuropathy.

Having said this, two clinically recognized conditions often complicate the management of female Bladder outflow obstruction.

FOWLER'S SYNDROME

Fowler's syndrome in strict terms is not urinary tract obstruction. But since it presents in such a peculiar way that unless precisely diagnosed it can be confused with infravesical obstruction leading to retention.

Typically it affects young women from 13 to 30 years, who present with insidiously developing painless urinary retention, which may harbor over 1000 mls at a time. Nearly 40% of these young women have polycystic ovary disease. However hallmark of diagnosis is strictly neurophysiologic abnormalities of the external urethral sphincter. This muscle must be precisely accessed by concentric needle electrode and its electrophysiological response should be analyzed. Typical changes are complex repetitive discharges and decelerating bursts. Audio signals arising from these activities typically produce the noise of "whales in the ocean". Other significant findings of Fowler's syndrome are abnormally high static urethral profile pressure and increased volume of the intrinsic rhabdosphincter on Ultrasound or MRI.

This syndrome is named after Clare Fowler, who described electrophysiological responses of the urethral rhabdosphincter in young women in urinary retention of unexplained nature.[16]

DYSFUNCTIONAL VOIDING

Also referred to as learned voiding dysfunction is essentially a faulty toilet training and wrong habits during voiding. These young girls fail to relax the pelvic floor, but instead contract the entire pelvic floor musculature in an intermittent manner. This results in interrupted flow, straining to void, very high intravesical pressures and a whole cascade of phenomena that may follow an organic obstruction. Indeed, the obstruction is entirely functional and can be demonstrated well on multichannel Urodynamics with or without video [Figure 5].

MANAGEMENT OF FEMALE BLADDER OUTFLOW OBSTRUCTION

The sensitivity of the bladder and the urethra to the action of oestrogens has long been recognized. It is postulated that the female urethra may be susceptible to atrophic senile urethritis compared to senile vaginitis as a result of oestrogen deprivation.[2] It is also generally believed that the relative loss of "Urethral Wall compliance" may be responsible for obstruction in the urethra in postmenopausal women. However there is no conclusive evidence that the Hormone Replacement Therapy (HRT) either systemic or topical has any significant role in the management of Bladder outlet Obstruction in females.

Sheer mechanical dilatation of the urethra can offer relief of a stricture in the short term but has a high recurrence rate. Empirical urethral dilatation is a popular mode of treatment but has no evidence of support in the literature.

Urethral obstruction arising from iatrogenic reasons such as surgery for stress urinary incontinence deserves a special mention. Colposuspension procedures such as Marshall Marshetti and Krantz operation had a higher incidence of producing bladder outlet obstruction, presumably due to the element of fixity of the urethra to the back of the Symphysis Pubis. Incidence

of obstruction occurring after Burch procedure is comparatively low, since the Urethra remains significantly mobile. In either case, obstruction must be dealt with by removing the offending sutures.

Current day use of tension free mid urethral slings, too, has a low but significant incidence of bladder outlet obstruction. The concept of "Hypercontinence" stems from the inadvertent tightness of the sling. Since there is no way of knowing the "Optimum" tension (or laxity) in the sling at the time of surgery, some incidence of overcorrection is likely to occur. The patient usually presents with increasing difficulty in passing urine and sometimes with complete urinary retention. Division of the sling in midline below the urethra usually settles the matter and curiously without affecting the continence. Division of the sling must be considered within three weeks of initial surgery in order to avoid permanent features of urethral distortion, which may arise from progressive fibroblastic reaction around the polypropylene mesh with time.[17] Preoperative Urodynamic investigation generally detects Underactive detrusor function (so common in the elderly age group), which can predict the possibility of urinary retention and symptoms of obstruction, postoperatively.[18] Removal of the polypropylene mesh can be a very difficult and a messy procedure, particularly after three weeks of insertion and should largely be avoided.

TREATMENT OF FOWLER'S SYNDROME

Treatment of the patient with established diagnosis of Fowler's syndrome is perhaps more perplexing than the diagnosis.

Till the time of writing this article, Sacral Neuromodulation is the most satisfactory mode of therapy (see the note on "Sacral Neuromodulation"). Alternative modalities have mostly been experimental and have not established their place fully in practice. One of them is injection of Botulinum Toxin into the external urethral sphincter. Biofeedback may also have a role in treating Fowler's syndrome. Patients, who are refractory to these modalities, may resort to continent diversion with a Mitrofanoff like stoma or a simple indwelling Suprapubic catheter.

The treatment of dysfunctional voiding is reversal and retraining of the toilet habits. The patient is usually normal neurologically. Biofeedback may be of use in some cases. Refractory cases may be offered ISC and some cases urinary diversion, depending on the severity and extent of the problem. Sacral neurostimulation (Neuromodulation) has shown a promise in the management of urinary retention in women, but it appears to be a more suitable proposition in idiopathic urinary retention. Its efficacy in the management of Dysfunctional voiding and Fowler's syndrome remains to be proven.[19]

CONCLUSION

Although bladder outflow obstruction is uncommon in women it poses a diagnostic and therapeutic challenge to clinicians. Good clinical history, thorough physical examination and complete urodynamic evaluation are the mainstay in the diagnosis.

Medical therapy has a limited value in treating this condition. HRT has no proven value in the treatment of female bladder outlet obstruction. Endoscopic division of stricture has a promising cure rate, but not without an incidence of recurrence.

Surgical options are possible but pose a risk of damage to delicate continence mechanisms in females. Intermittent self catheterisation may have to be instituted at least in the short term.

Dysfunctional voiding and Fowler's syndrome pose special problems. They usually demand a thorough Urodynamic workup and a multimodality approach to their treatment.

In summary, treatment of female bladder outlet obstruction needs an individualized approach based on a very careful evaluation.

At the end of the day, bladder outlet obstruction in females remains a challenging urological condition and demands expertise in its investigations and management.

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